[0075] Next, the manufacturer metallizes the vias **1126**, **1132**, **1134**, and **1138**. In one exemplary technique, the manufacturer first places the device in a low pressure, or vacuum, environment, disposes metal over the vias **1126**, **1132**, **1134**, and **1138**, heats the device **1100**, and allows at least some of the metal to flow (by, for example, capillary action) into the vias **1126**, **1132**, **1134**, and **1138**, and contact the metallization layers **1122**, **1158**, or **1159** as the case may be. The metal may be any conductive material. For example, in certain embodiments, the material includes indium, copper, platinum, gold, silver, and/or alloys thereof. After the above-described metallizing, certain portions of the interconnects **1124**, **1128**, **1130**, and **1136** lie above the upper surface **1105***a* of the encapsulating layer **1105** in order to electrically contact other metallization layers, such as the depicted metallization layers **1180** for interconnects **1128** and **1130** or the metallization layer **1182** for the interconnects **1136**, **1140**, and **1144**. The portions of the interconnects lying above the upper surface **1105***a* may also electrically contact other interconnects yet to be formed, such as interconnect **1168**.

[0076] As mentioned above, the manufacturer forms the layers **1104**, **1106**, **1108**, and **1110** sequentially. After forming the layer **1104**, the manufacturer uses similar processes to form layer **1106**. More particularly, the manufacturer deposits and patterns the metallization layers **1180** and **1182** over the encapsulating layer **1105**. After depositing the metallization layer **1122**, the manufacturer arranges and affixes the first second set of components **1114** and **1115** via adhesive layers **1172** and **1174** (step **1314**). As was the case with layer **1104**, the manufacturer may optionally deposit a thin film dielectric layer (not shown) over the metallization layers **1180** and **1182** to insulate the metallization layers **1180** and **1182** from the components **1114** and **1115**. In the depicted embodiment, the adhesive bonding layers **1172** and **1174** are disposed between the metallization layers **1180** and **1182** and the components **1114** and **1115**. In one exemplary technique, the manufacturer applies the adhesive layers **1172** and **1174** directly over the encapsulating layer **1105** and/or the metallization layers **1180** and **1182**, and then aligns and presses the components **1114** and **1115** to affix the components **1114** and **1115** to the adhesive layers **1172** and **1174**. The adhesive layers **1172** and **1174** may be disposed such that the metallization layer **1122** electrically contacts the components **1114** and **1115**.

[0077] The manufacturer then deposits and optionally patterns metallization layers **1202** and **1204**, disposes the second encapsulating layer **1107** (step **1316**) over and laterally between the components **1114** and **1115**, soft bakes the encapsulating layer **1107**, planarizes the encapsulating layer **1107**, and hard bakes the encapsulating layer **1107**, and forms interconnects **1168**, **1206**, **1208**, **1210**, **1212**, and **1214** using similar techniques to those described in connection with layer **1104**.

[0078] The components **1112-1119** may have edges that form angular interfaces with the encapsulant. By way of example, component **1115** has edge **1115***a* that forms an angular interface with encapsulating layer **1107**. This angular interface can stress and possibly crack the encapsulating layer **1107**. In certain embodiments, the manufacturer selectively removes a portion **1199** of the encapsulating layer **1107** in order to remove the encapsulating layer around this angular interface. The manufacturer may leave the portion **1199** as an empty via, or fill it with a compliant material.

[0079] In certain configurations, the multi-component substrate **1102** is sacrificial, and in an optional final step, the manufacturer removes the multi-component substrate **1102**. In one such exemplary technique, the multi-component substrate **1102** is dissolved. Additionally, it is noted that although device **1100** includes four layers **1104**, **1106**, **1108**, and **1100**, the manufacturer can include as many or as few layers as desired.

[0080] As mentioned above, the components **1112-1119** can comprise a variety of subsystem components that serve a variety of functions. The components **1112-1119** may be predefined, in that they are individually fabricated before they are arranged within the device **1100**. The components **1112-1119** may include integrated circuit devices. The integrated circuit devices may be digital integrated circuit devices or analog integrated circuit devices.

[0081] In certain implementations, the components **1112-1119** include components for communication, such as wireless communication or optical communication. The components may include radio frequency transmitters and/or radio frequency receivers. More generally, they may include radio frequency integrated circuits, or microwave integrated circuits. Additionally, or alternatively, the components may include optical signal processors including optical signal transmitters, such as light emitting diodes (LEDs), tunable diodes, or lasers, and optical signal receivers, such as photodiodes. Other components and structures for routing optical signals will be discussed in more detail below.

[0082] In certain embodiments, the components include sensors, such as mechanical sensors, thermal sensors, optical sensors, electrical sensors, and/or chemical sensors. As will be discussed in more detail below, the chemical sensors may be in fluid communication with external fluid samples via microfluidic channels for chemical sensing and analysis. Other exemplary sensors include accelerometers, tilt sensors, and gyroscopes.

[0083] The components may include transducers, such as actuators. Exemplary actuators include mechanical actuators, thermal actuators, optical actuators, electrical actuators, chemical actuators, and fluidic actuators. The transducers may also include motors, pistons, relays, microphones, piezoelectric devices, batteries, and/or fuel cells.

[0084] Although many of the possible component types mentioned above are active components, they may also be passive components. For example, the components may include inductors, capacitors, and/or resistors.

[0085] FIG. **15** shows a close-up view a second portion of the device **1100** of FIG. **12**, and in particular shows microfluidic features for heat dissipation and for environmental sampling according to an illustrative embodiment of the invention. More particularly, the depicted component **1117** generates heat and must be cooled to prevent overheating. The metallization layer **1184** couples to the component **1117**, and a microfluidic heat dissipation channel **1160** is filled with gas or liquid and thermally couples the metallization layer **1184** to ambient air generally indicated at **1186**. The heat dissipation channel **1160** draws heat away from the component **1117** and towards the ambient air **1186** by convection. In alternative embodiments, the microfluidic channel draws heat to a heat reservoir (not shown) or draws heat towards other components of the device **1100** that may require higher operating temperatures.

[0086] The microfluidic channel **1160** can be patterned into the encapsulating layers **1109** and **1111** using any of the